CLAIMS

We claim:

1. An optical device for processing wavelength divisional multiplexed optical signals between a first port communicating odd channels and even channels and second and third ports communicating odd and even channels, respectively, and the optical device comprising:

a linear polarizer coupled to the first port for linearly polarizing the optical signals;

a first filter with a first free spectral range substantially corresponding to a channel spacing between adjacent odd or even channels, the first filter being coupled with the linear polarizer for splitting and combining odd and even channel sets depending on a propagation direction; and

a second filter optically coupled with the first filter and the second and third ports, the second filter having a second free spectral range substantially corresponding to the channel spacing between adjacent odd or even channels, the second filter being coupled with the first filter for optical processing of odd and even channels therewith.

2. The optical device of claim 1, wherein the first filter operates as a full waveplate to a selected one of an odd channel set and an even channel set and as a half waveplate to the other of the odd channel set and the even channel set.

3. The optical device of claim 2, wherein the second filter operates as a half waveplate to the selected one of the odd channel set and the even channel set and as a full waveplate to the other of the odd channel set and the even channel set.

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4. The optical device of claim 1, wherein each of the first filter and the second filter comprises a pair of filter cells coupled to one another, each of the pair of filter cells including a fundamental filter cell and a harmonic filter cell, with the fundamental filter cell in the first filter exhibiting the first free spectral range and the fundamental filter cell in the second filter exhibiting the second free spectral range.

5. The optical device of claim 4, wherein the harmonic filter cell exhibits a harmonic free spectral range corresponding to an integer fraction, $1/n$, of the channel spacing between adjacent odd and even channels, wherein n is an integer.

6. The optical device of claim 1, wherein each of the first filter and the second filter comprises:

two pairs of delay paths for optically processing the odd and even channels, each of the two pairs exhibiting optical pathlength differences that correspond to a sum of a Fourier series including a fundamental frequency component corresponding to the channel spacing between adjacent odd and even channels; and

optical couplers interlaced with the two pairs of delay paths to asymmetrically split and combine the communication channels across each of the two pairs of delay paths to effect an adjustment of stopbands between adjacent odd channels and adjacent even channels.

7. The optical device of claim 6, wherein the optical couplers comprise polarization couplers that split and combine optical signals depending on a polarization thereof.

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8. The optical device of claim 6, wherein the optical couplers comprise intensity couplers that split and combine optical signals depending on an intensity thereof.

9. The optical device of claim 6, wherein asymmetries of coupling in the first filter and the second filter correspond with one another.

10. The optical device of claim 1, wherein each of the first filter and the second filter comprises a birefringent crystal that has an optical axis normal to a propagation path of the optical signal and splits and combines odd and even communication channels depending on a propagation direction.

11. The optical device of claim 10, wherein an optical pathlength difference of extraordinary and ordinary ray paths of the first filter differs from a corresponding pathlength difference of extraordinary and ordinary ray paths of the second filter by an odd integer multiple of $\lambda/2$.

12. The optical device of claim 1, wherein the channel spacing between adjacent channels in the optical signal is equal to or less than 50 GHz.

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13. An optical device for processing wavelength divisional multiplexed optical signals between a first port communicating odd channels and even channels and second and third ports communicating odd and even channels, respectively, and the optical device comprising:

a linear polarizer coupled to the first port for linearly polarizing the optical signals;

a first filter coupled with the linear polarizer for splitting and combining odd and even channel sets depending on a propagation direction, wherein the first filter operates as a full waveplate to a selected one of an odd channel set and an even channel set and as a half waveplate to the other of the odd channel set and the even channel set; and

a second filter optically coupled with the first filter and the second and third ports, the second filter, the second filter being coupled with the first filter for optical processing of odd and even channels therewith wherein the second filter operates as a half waveplate to the selected one of the odd channel set and the even channel set and as a full waveplate to the other of the odd channel set and the even channel set.

14. The optical device of claim 13, wherein with the first filter has a first free spectral range substantially corresponding to a channel spacing between adjacent odd or even channels.

15. The optical device of claim 13, wherein the second filter has a second free spectral range substantially corresponding to the channel spacing between adjacent odd or even channels.

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16. The optical device of claim 13, wherein each of the first filter and the second filter comprises:

two pairs of delay paths for optically processing the odd and even channels, each of the two pairs exhibiting optical pathlength differences that correspond to a sum of a Fourier series including a fundamental frequency component corresponding to the channel spacing between adjacent odd and even channels; and

optical couplers interlaced with the two pairs of delay paths to asymmetrically split and combine the communication channels across each of the two pairs of delay paths to effect an adjustment of stopbands between adjacent odd channels and adjacent even channels.

17. The optical device of claim 16, wherein the optical couplers comprise polarization couplers that split and combine optical signals depending on a polarization thereof.

18. The optical device of claim 16, wherein the optical couplers comprise intensity couplers that split and combine optical signals depending on an intensity thereof.

19. The optical device of claim 13, wherein the channel spacing between adjacent channels in the optical signal is equal to or less than 50 GHz.

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20. An multiplexer/demultiplexer for use with wavelength divisional multiplexed optical signals, the multiplexer/demultiplexer comprising:

a first port communicating odd channels and even channels;

a second port communicating odd channels;

a third port communicating even channels;

a linear polarizer coupled to the first port for linearly polarizing the optical signals;

a first filter with a first free spectral range substantially corresponding to a channel spacing between adjacent odd or even channels, the channel spacing between adjacent odd or even channels being equal to or less than 100 GHz, wherein the first filter:

is coupled with the linear polarizer for splitting;

combines odd and even channel sets depending on a propagation direction; and

operates as a full waveplate to a selected one of an odd channel set and an even channel set and as a half waveplate to the other of the odd channel set and the even channel set; and

a second filter optically coupled with the first filter and the second and third ports, wherein the second filter:

has a second free spectral range substantially corresponding to the channel spacing between adjacent odd or even channels;

operates as a half waveplate to the selected one of the odd channel set and the even channel set and as a full waveplate to the other of the odd channel set and the even channel set; and

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is coupled with the first filter for optical processing of odd and even channels therewith.

21. The optical device of claim 20, wherein each of the first filter and the second filter comprises a pair of filter cells coupled to one another, each of the pair of filter cells including a fundamental filter cell and a harmonic filter cell, with the fundamental filter cell in the first filter exhibiting the first free spectral range and the fundamental filter cell in the second filter exhibiting the second free spectral range, the harmonic filter cell exhibiting a harmonic free spectral range corresponding to an integer fraction, $1/n$, of the channel spacing between adjacent odd and even channels, wherein n is an integer.

22. The optical device of claim 20, wherein each of the first filter and the second filter comprises:

two pairs of delay paths for optically processing the odd and even channels, each of the two pairs exhibiting optical pathlength differences that correspond to a sum of a Fourier series including a fundamental frequency component corresponding to the channel spacing between adjacent odd and even channels; and

optical couplers interlaced with the two pairs of delay paths to asymmetrically split and combine the communication channels across each of the two pairs of delay paths to effect an adjustment of stopbands between adjacent odd channels and adjacent even channels.

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